



2004 ENVIRONMENTAL MONITORING OVERVIEW

Water quality monitoring, assessment and management in Massachusetts are sequentially performed in accordance with a rotating five-year watershed schedule. Surface waters are typically monitored during Year 2 of the cycle. Three general themes were emphasized in the 2004 Environmental Monitoring Program Plan: 1) Assessment of unassessed waters; 2) locating sources of fecal coliform contamination for corrective action; and 3) obtaining data in support of TMDL development. The Division of Watershed Management (DWM) Watershed Planning Section performed monitoring activities in 2004 primarily within the Merrimack and French & Quinebaug watersheds. Additional lake monitoring was carried out in other "Year 2" watersheds and the identification of bacteria sources was completed in "off-cycle" watersheds.

In consultation with appropriate groups (e.g., EPA, USGS, watershed associations, etc.) DWM monitoring coordinators reviewed historical data and information, identified "unassessed waters, conducted reconnaissance, examined GIS datalayers, reviewed NPDES and water withdrawal permits and formulated individual watershed monitoring plans that were subsequently incorporated into a single comprehensive *Quality Assurance Project Plan (QAPP) for 2004 Watershed Monitoring*. This plan was prepared to ensure effective and efficient sampling design and to ensure that all data gathered met specific data quality objectives (e.g., the data were representative of field conditions; were as accurate and precise as possible given available monitoring resources). In addition, existing and newly revised programmatic QAPPs were used for selected DWM monitoring functional elements such as biological and habitat assessment and for baseline lake sampling in support of the development of TMDLs.

While some of the DWM monitoring activities in 2004 were focused directly on specific issues in the respective "Year Two" watersheds, the majority of the monitoring in the Merrimack and French & Quinebaug watersheds was aimed at providing the necessary information to assess the extent to which water bodies are supporting their intended uses, as defined by the Massachusetts Surface Water Quality Standards. This information will be used in the preparation of individual watershed assessment reports, the Massachusetts Integrated List of Waters submitted to the EPA in fulfillment of sections 305b (Summary of Water Quality) and 303d (List of Impaired Waters) of the Clean Water Act (CWA), and will provide, in part, "the percent of waters that are safe for fishing, and support aquatic life and recreation", and other BRP "environmental indicators" identified in the State-EPA Performance Partnership Agreement (PPA).

Historically, DWM's yearly water quality sampling plans to assess surface water quality conditions in Massachusetts have been successful in providing valuable data for waterbody health assessment and development of TMDL implementation plans, in support of Clean Water Act, Section 305(b) and 303(d) requirements. Due to limits of time and resources, however, these traditional monitoring plans have not been very successful in 1) identifying with confidence the specific sources of pollution that cause water quality impairments and; 2) implementing

follow-up actions for remediation. In recognition of this limitation a decision was made in 2004 to forego assessment monitoring in the Parker, Boston Harbor, Narragansett/Mount Hope Bay and Cape Cod drainage areas in order to perform a Pilot Study aimed at identifying the locations of point and nonpoint sources of fecal contamination. The Blackstone and Sudbury watersheds were chosen for study to minimize survey logistical constraints and because historical data indicated that recreational use-impairments typically occur in these watersheds. An important component of the Pilot Study was the establishment of laboratory facilities at the DWM office in Worcester to perform bacteriological analyses in accordance with Standard Method 9223 ("Enzyme Substrate Test"). The installation of this equipment eased sample holding time constraints and allowed for the rapid turn-around of E. coli and Enterococcus results. The Pilot Study utilized an iterative sampling regimen to bracket or "track" the sites of bacterial "hot spots" which were then shared with DEP regional office personnel and local officials who could initiate corrective actions.

Efforts to gather data in support of the Massachusetts TMDL program continued in 2004. After a one-year hiatus in 2003 to allow for monitoring solely to support nutrient criteria development for lakes, a decision was made to resume surveys in 303(d)-listed lakes and ponds to provide information for the development of TMDLs for those water bodies. Twenty-four lakes were chosen for study, and all but two of them were situated within the "Year 2" watersheds scheduled for monitoring by the DWM. Nonetheless, continuous (24-48 hour) dissolved oxygen measurements were also obtained from approximately half of these lakes to support ongoing nutrient criteria development activities.

As in 2003 field and laboratory resource limitations prevented the DWM from providing routine fish toxics monitoring in the "Year 2" watersheds. Nonetheless, sampling was accomplished at three lakes and in the Lowell Canal system in response to public requests for fish toxics monitoring. (Also, the MADEP's Office of Research and Standards (ORS) continued some fish contaminant monitoring using a private contractor for field collections.)

A brief summary of DWM monitoring activities accomplished in 2004, both in the "Year Two" watersheds as well as throughout the state, is presented below.

BOSTON HARBOR (MYSTIC)

TMDL Support:

Monitoring in the Mystic watershed was limited to six (6) lakes and ponds that were surveyed to provide data in support of the DWM TMDL program. All of these lakes and ponds were listed on the 2002 303(d) List of Impaired Waters and are candidates for TMDL development. Working with EPA, a plan was developed to gather sufficient data from each lake to confirm their impairment status and to support TMDL work. Lake monitoring included the preparation of a bathymetric map (if not already available), secchi disc readings, in situ water quality profile measurements (i.e. temperature, dissolved oxygen, pH, conductance) at one or more stations, water quality sampling for phosphorus analysis, chlorophyll a determinations and the analysis of apparent color. Each of the following lakes was sampled on three separate occasions, although Hydrolab profiles were obtained only once.

Name	Municipality	Waterbody Identification Number
Blacks Nook	Cambridge	MA71005
Ell Pond	Melrose	MA71014
Horn Pond*	Woburn	MA71019
Judkins Pond	Winchester	MA71021
Mill Pond	Winchester	MA71031
Wedge Pond	Winchester	MA71045

* included continuous dissolved oxygen measurements for nutrient criteria development

CAPE COD

TMDL Support:

Monitoring on Cape Cod was limited to twelve (12) lakes and ponds that were surveyed to provide data in support of the DWM TMDL program. Ten of these lakes and ponds were listed on the 2002 303(d) List of Impaired Waters and are candidates for TMDL development. Lovells and Hinkleys ponds were not listed but were suspected of being impaired. Working with EPA, a plan was developed to gather sufficient data from each lake to confirm their impairment status and to support TMDL work. Lake monitoring included the preparation of a bathymetric map (if not already available), limited mapping of aquatic vegetation, secchi disc readings, in situ water quality profile measurements (i.e. temperature, dissolved oxygen, pH, conductance) at one or more stations, water quality sampling for phosphorus analysis, chlorophyll a determinations and the analysis of apparent color. Each of the following lakes was sampled on three separate occasions, although Hydrolab profiles were obtained only once.

Name	Municipality	Waterbody Identification Number
Crystal Lake	Orleans	MA96050
Great Pond	Eastham	MA96115
Hinkleys Pond	Harwich	MA96140
Long Pond	Brewster/Harwich	MA96183
Lovells Pond*	Barnstable	MA96185
Lower Mill Pond	Brewster	MA96188
Red Lily Pond	Barnstable	MA96257
Ryder Pond	Truro	MA96268
Santuit Pond*	Mashpee	MA96277
Sheep Pond	Brewster	MA96289
Upper Mill Pond*	Brewster	MA96324
Walkers Pond*	Brewster	MA96331

* included continuous dissolved oxygen measurements for nutrient criteria development

FRENCH & QUINEBAUG

1) Assessment monitoring:

The primary objective of assessment monitoring was to determine the aquatic life and recreational use status of “unassessed” rivers and streams throughout the French & Quinebaug watersheds by conducting biological (macroinvertebrates, fish, periphyton, bacteria) sampling, habitat assessments, and in-situ water quality measurements (multiprobe - dissolved oxygen,

percent saturation, temperature, pH, depth, and specific conductivity).

Samples for bacterial analysis (fecal coliform and E. coli) were collected from twenty-four (24) sites (see table below) on May 26, June 16, July 14, August 11 and September 15. Dissolved oxygen (pre-dawn) and other field parameters were measured at these sites on July 13, August 10 and September 14. Optical brightener samplers were deployed and additional bacteria samples were collected for analysis using the new bacteria testing system at the DWM to locate the source of high bacteria levels encountered during the assessment monitoring in Cohassee Brook. Also, in cooperation with the DWM, nutrient sampling was conducted by the United States Geological Survey (USGS) at five (5) sites to support ongoing nutrient criteria development activities.

Benthic macroinvertebrate, periphyton and fish community assessments were performed between late August and mid-September (i.e., low-flow months) according to the table below. Habitat assessments were also performed at most of these sites and will be augmented by habitat observations made during the bacteria and multiprobe water quality surveys. The major goals of these activities were: 1) To assess the aquatic life use status for 305(b) reporting requirements, 2) To evaluate water quality and habitat quality of previously unassessed stream segments, and 3) To assess the effects of known or potential point and nonpoint source pollution inputs. The macroinvertebrate and fish sampling procedures utilized Rapid Biomonitoring Protocols (RBPs). Periphyton assessments were performed at ten (10) sites where macroinvertebrate and fish sampling was conducted. A modified USGS protocol was followed whereby samples were obtained from three substrates collected along a transect through the riffle zone and retained for taxonomic identification in the laboratory.

River/Stream	Monitoring Site Description (sample type*)
Burncoat Brook	Near mouth, dnst. from power lines, off Pine St., Leicester (1, 2, 5)
French River	Dnst. from Clara Barton Rd., upst. from power lines, Oxford, MA (1, 2, 3, 5)
Little River	Upst. from Turner Rd., above Buffumville Lake, Charleton, MA (1, 2, 3, 5)
Hatchet Brook	Upst. from South St., Southbridge, MA (1, 2, 3)
Cohassee Brook	Near mouth, at Oak Ridge Cemetery, Southbridge, MA (1, 2, 3)
McKinstry Brook	Upst. from Pleasant St., Southbridge, MA (1, 2, 3, 4)
Lebanon Brook	3 km upstream from Rt. 131 (above small pond), Southbridge, MA (1, 2, 3)
Tufts Branch	Upst. from Rt. 197, Dudley, MA (1, 2, 3, 4)
Stevens Brook	Upst. from Brimfield Rd., Brimfield, MA (1, 2, 3, 4)
Lowes Brook	Dnst. from Rt. 12, Oxford, MA (1)
Wellington Brook	Dnst. from Chimney Pond, near Millbury Rd., Oxford, MA (1)
Browns Brook	0.75 km upst. from mouth, southwest of May Brook Rd., Holland, MA (1, 2, 3)
Hamant Brook	Upst. from dammed impoundment near mouth, Sturbridge, MA (1, 2, 3, 4)
Grindstone Brook	150m dnst from Rt. 56, Leicester, MA (1, 2, 3)
Sucker Brook	Dnst. from Kingsbury Rd., Webster, MA (1, 2, 3, 4)
Unnamed trib ("East Brook")	At footbridge immediately dnst. from Rt. 20, Brimfield, MA (bio on upstream side of Rt. 20) (1, 2, 3, 4, 5)
Unnamed trib ("Potter Brook")	Dnst. from Potter Village Rd., Charleton, MA (1, 2, 3, 4)
West Brook	Dnst. from Rt. 20, Brimfield, MA (1, 2, 3, 5)
Mountain Brook	Dnst. from Rt. 20, Brimfield, MA (1, 2, 3)
Leadmine Brook	Upst. from I-84 at MA-CT line, near abandoned rest area, Sturbridge, MA (1, 2, 3, 4)

Mine Brook	Immed. upst. from Mine Brook Rd., Webster, MA (1, 2, 3, 4)
Rocky Brook	100m Dnst. from footpath off High St., adjacent to Thompson Rd. and railroad bed, Douglas, MA (1, 2, 3)
Unnamed trib ("Keenan Brook")	Near mouth, at sand/gravel drive off Dresser Hill Rd., Southbridge, MA (1, 2, 3)
Browns Brook	Upst. from Mine Brook Rd., Webster, MA (1, 2, 3, 4)

*1 - Dissolved oxygen/multi-probe and bacteria samples, 2 – Macroinvertebrate assessment, 3 – Fish population assessment, 4 – Periphyton assessment, 5 – Nutrient sampling (USGS)

Also, the Massachusetts Division of Fish & Game (MDFG) performed fish population assessments at sixteen (16) locations in the French & Quinebaug watersheds. These are listed below.

Quinebaug River (three sites)
French River (two sites)
Tufts Branch
Cady Brook
Sucker Brook
Tributary to East Brimfield Reservoir

Grindstone Brook
Town Meadow Brook
Little River
Hatchet Brook
Tributary to Cedar Pond
Two (2) unnamed streams in Charlton

2) TMDL Support:

Four (4) lakes and ponds were surveyed to provide data in support of the DWM TMDL program. All of these lakes and ponds were listed on the 2002 303(d) List of Impaired Waters and are candidates for TMDL development. Working with EPA, a plan was developed to gather sufficient data from each lake to confirm their impairment status and to support TMDL work. Lake monitoring included the preparation of a bathymetric map (if not already available), limited mapping of aquatic vegetation, secchi disc readings, in situ water quality profile measurements (i.e. temperature, dissolved oxygen, pH, conductance) at one or more stations, water quality sampling for phosphorus analysis, chlorophyll a determinations and the analysis of apparent color. Each of the following lakes was sampled on three separate occasions, although Hydrolab profiles were obtained only once.

Name	Municipality	Waterbody Identification Number
Alum Pond*	Sturbridge	MA41001
Glen Echo Lake	Charlton	MA41017
Pistol Pond*	Sturbridge	MA41057
Wielock Pond*	Dudley	MA41056

* These lakes plus Dutton Pond, Leicester and Sibley Pond (North Basin), Charlton included continuous dissolved oxygen measurements for nutrient criteria development

MERRIMACK

1) Assessment monitoring:

The primary objective of assessment monitoring was to determine the aquatic life and recreational use status of "unassessed" rivers and streams throughout the Merrimack watershed by conducting biological (macroinvertebrates, fish, periphyton, bacteria) sampling,

habitat assessments, and in-situ water quality measurements (dissolved oxygen, percent saturation, temperature, pH, depth, and specific conductivity).

Samples for bacterial analysis (fecal coliform and *E. coli*) were collected from twenty-three (23) sites (see table below) on June 2, June 23, July 8, August 18 and September 9. Dissolved oxygen (pre-dawn) and other field parameters were measured at these sites on July 7, August 17 and September 8. Also, in cooperation with the DWM, nutrient sampling was conducted by the United States Geological Survey (USGS) at five (5) sites to support ongoing nutrient criteria development activities.

Benthic macroinvertebrate, periphyton and fish community assessments were performed between late July and mid-August (i.e., low-flow months) as indicated in the table below. Habitat assessments were also performed at most of these sites and will be augmented by habitat observations made during the bacteria and multiprobe water quality surveys. The major goals of these activities were: 1) To assess the aquatic life use status for 305(b) reporting requirements, 2) To evaluate water quality and habitat quality of previously unassessed stream segments, and 3) To assess the effects of known or potential point and nonpoint source pollution inputs. The macroinvertebrate and fish sampling procedures utilized Rapid Biomonitoring Protocols (RBPs). Periphyton assessments were performed at twelve (12) sites where macroinvertebrate sampling was conducted. A modified USGS protocol was followed whereby samples were obtained from three substrates collected along a transect through the riffle zone and retained for taxonomic identification in the laboratory.

River/Stream	Monitoring Site Description (sample type*)
Martins Pond Brook	Dnst. from footbridge at end of Loomis Lane, Groton, MA (1, 2, 3, 4)
Lawrence Brook	Dnst. from Shelburne Ave., Tyngsborough, MA (1, 3)
Deep Brook	Dnst. from Ledge Rd., Chelmsford, MA (1, 3)
Black Brook	Upst. from Westford St., Lowell, MA (1, 2, 3)
Richardson Brook	Upst. from Methuen St., Dracut, MA (1, 2, 3, 4, 5)
Trout Brook	Upst. from Kenwood St., Dracut, MA (1, 3)
Trull Brook	Dnst. from River Rd., Tewksbury, MA (1, 2, 3, 4)
Bare Meadow Brook	Dnst. from Renfrew St., Methuen, MA (1, 3, 5)
Johnson Creek	Dnst. from Center Rd., Groveland, MA (1, 3)
Little River	Dnst. from Winter St., Haverhill, MA (1)
Powwow River	Near mouth, off Mill St., Amesbury, MA (1, 2, 4, 5)
Back River	Upst. from Clinton Ave., Amesbury, MA (1)
Salmon Brook	Dnst. from Ridge Rd., Nashua, NH (1)
Bennetts Brook	Dnst. from Willow Rd., Ayer, MA (1, 2, 3, 4, 5)
Tadmuck Brook	Upst. from Lowell Rd., Westford, MA (1, 2, 3, 4)
Bartlett Brook	Dnst. from Rt. 113, Methuen, MA (1, 2, 3, 4)
Creek Brook	Upst. from Lowell Ave., Haverhill, MA (1, 2, 3, 4)
East Meadow River	Upst. from Thompson Rd., Haverhill, MA (1, 3)
Fish Brook	Dnst. from River Rd., Andover, MA (1, 2, 3, 4, 5)
Bridge Meadow Brook	Dnst. from road to Elementary School, Tyngsborough, MA (1, 2, 3, 4)
South Br. Sougegan R.	1.5 km dnst. from Jones Hill Rd., Ashby, MA (2, 4)
Argella Brook	Off Baldwin Terrace, off Rt. 97, Groveland, MA (1, 3)
Joint Grass Brook	Dnst. from Main St., Dunstable, MA (1, 3)
Peppermint Brook	Dnst. from Lakeview Ave., Lowell, MA (1, 2, 3, 4)

*1 - Dissolved oxygen/multi-probe and bacteria samples, 2 – Macroinvertebrate assessment, 3 – Fish population assessment, 4 – Periphyton assessment, 5 – Nutrient sampling (USGS)

2) Monitoring for Nutrient Criteria Development:

Continuous (24-48 hour) dissolved oxygen measurements were obtained from the Essex Impoundment of the Merrimack River in Lawrence, MA to support the ongoing nutrient criteria derivation effort.

ADDITIONAL MONITORING ACTIVITIES – Some monitoring projects were carried out in watersheds that were not actually in “Year 2” of the five-year watershed cycle. These are described below:

1) Bacteria Source Tracking:

A pilot Bacteria Source Tracking Protocol was developed to apply and evaluate new monitoring strategies aimed at providing site-specific data to enable identification and abatement of specific bacterial pollution sources. Because this was a targeted plan that focused on studying bacteria impairments in specific, localized subwatershed areas and/or reaches, rather than providing data on the general status of waters over a wide area, the monitoring design varied significantly from assessment monitoring. Selected subwatersheds in the Sudbury and Blackstone watersheds were used to test the new protocol.

Multiple sampling rounds for *E. coli* as well as analysis of other parameters that may provide information to help distinguish between human and non-human sources of bacteria (such as optical brighteners, etc.) were used in an attempt to pinpoint hot spots and identify bacteria sources. Data from one round of sampling provided the clues to direct the focus of the next sampling round. Because of this, the quick turnaround of data for immediate review by survey coordinators, provided through the new on-site bacteria testing facilities, was essential. As data were gathered, reviewed and evaluated, an in-house Source Tracking Advisory Team (STAT) met to discuss where, when and why to sample next. “Hot spots” and potential or likely locations of pathogen sources were isolated and confirmed, prior to taking the next appropriate actions to try to correct the problem(s).

Sudbury Watershed

Targeted monitoring for bacteria was concentrated in the Baiting Brook (15 sampling events) and Eames Brook (12 sampling events) sub-watersheds in Framingham, MA where grab samples for *E. coli* bacteria were obtained. In addition, an unnamed tributary to the Sudbury River in Framingham was sampled 11 times. Finally, five (5) stations along the upper four miles of the Sudbury River were sampled five times in an attempt to find an appropriate river mile at which to concentrate additional bacteria source tracking efforts. Both dry weather and wet weather surveys were conducted in all of these study units.

Blackstone Watershed

DWM conducted water sampling for *E. coli* analyses in sub-watersheds of the Blackstone River Basin for which historical data had indicated elevated fecal coliform counts. The sub-watersheds monitored were the Peters River (17 sampling events) and Singletary Brook (9 sampling events). Again, both dry weather and wet weather surveys were conducted in these

two study units.

2) Fish toxics monitoring:

DWM completed fish sampling in response to public requests through the Inter-agency Fish Toxics Committee at Forge Pond (Westford), Nabnasset Pond (Westford), Lost Lake (Groton) and at three sites along the Merrimack and Concord river canal system in Lowell.

3) TMDL Support:

In addition to Year 2 TMDL lakes, two lakes - Martins Pond, North Reading (MA92038 - Ipswich watershed) and Long Pond, Tewksbury (MA83010 - Shawsheen watershed) - were surveyed to provide data in support of the DWM TMDL program. Although both of these lakes and ponds were listed on the 2002 303(d) List of Impaired Waters no apparent anthropogenic sources of nutrients could be identified and data were collected in 2004 primarily to confirm that high phosphorus concentrations and color encountered in previous surveys could be attributed to natural wetland interactions. Lake monitoring included the preparation of a bathymetric map (if not already available), secchi disc readings, in situ water quality profile measurements (i.e. temperature, dissolved oxygen, pH, conductance) at one or more stations, water quality sampling for phosphorus analysis, chlorophyll a determinations and the analysis of apparent color. Each lake was sampled on two separate occasions.

4) Additional Monitoring for Nutrient Criteria Development:

To support the ongoing nutrient criteria derivation effort continuous (24-48 hour) dissolved oxygen measurements were obtained from eleven "Year 2" lakes (noted above) and an additional ten (10) water bodies listed in the table below:

<i>Name</i>	<i>Municipality</i>	<i>Waterbody Identification Number</i>
Assabet River Reservoir	Westborough	MA82004
Moody Street Pond	Waltham	MA72147
Jennings Pond	Natick	MA72053
Upper Mystic Lake	Winchester/Arlington/Medford	MA71043
French Pond	Easton	MA62074
Mount Hope Mill Pond	Taunton	MA62122
Savery Pond	Middleborough	MA62167
Parker Mills Pond	Wareham	MA95115
Mill Pond	Wareham	MA95105
Tremont Mill Pond	Wareham	MA95150

5) Perchlorate Sampling:

Water samples for perchlorate analysis were collected on eight separate occasions from selected locations in the Concord and Merrimack rivers in an effort to identify potential sources of this contaminant that was discovered in the Town of Tewksbury's municipal water supply.

6) Blue-green Algae Bloom Investigations:

DWM staff assisted the Massachusetts Department of Public Health (DPH) with the investigation of potentially toxic blue-green algae blooms in Quaboag Pond (Brookfield/East Brookfield) and the Charles River. This included water sampling on six different dates for toxicity testing (DPH) or phytoplankton taxonomic identifications and counts to determine whether the World Health Organization criterion for blue-green algae blooms was exceeded (DWM).

7) Taunton Cranberry Bog Investigation:

DWM biologists conducted a site investigation at an unnamed tributary to the Cedar Swamp River (Taunton Watershed) as a follow-up to biomonitoring carried out here in 2001 that revealed a severely impaired macroinvertebrate community downstream from a cranberry bog.

8) Quabbin Reservoir Survey:

DWM staff assisted Division of Fish and Game (DFG) personnel with a one-day water quality monitoring survey of Quabbin Reservoir in support of ongoing research by MADEP's Office of Research and Standards (ORS) on toxic contaminants in fish. The survey included *in situ* measurements of pH, temperature, and dissolved oxygen as well as sampling for DOC analysis at the Environmental Institute's Environmental Analysis Lab at Umass-Amherst.

9) Sudbury River Tributary Investigation:

At the request of the MADEP's Central Regional Office (CERO) DWM responded to a report of objectionable color and turbidity in a small unnamed tributary to the Sudbury River in Westborough. Water samples were collected from two sites and submitted to WES for analysis. In addition, bacterial analysis of two samples was performed at the DWM facility at Worcester.